PATENT SPECIFICATION

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PROVISIONAL SPECIFICATION

Improvements in or relating to Laminated Patterned Plastic Articles

I, GEORGE CLAUDE LEON UNDERWOOD, a British Subject, of 12, Girdlers Road, West Kensington, London, W.14, do hereby declare the nature of this invention to be as follows:—

The invention relates to laminated patterned plastic articles or to patterned parts of plastic articles.

In accordance with the invention, a patterned article or a patterned part of article made from plastic material is produced by superposition and assembly of two or more layers of transparent or translucent plastic material, one or all or all except one of which are differently but uniformly coloured, and one of which may be colourless, but which vary in thickness so that the density of shade in each layer corresponds to a part of the desired pattern or to complementary parts of the pattern, or to the pattern and its groundwork and which are also complementary in the sense that they fit together.

In a simple form, a patterned article may consist of two such layers, the darker of which is formed with one face flat and the other being contoured to give the required pattern, and the lighter of which, or the colourless layer forms a groundwork for the pattern and which has one surface contoured in a manner complementary to the contoured surface of the darker layer. The two layers are superposed, or one is formed *in situ* in the other so that their two contoured faces mate and inter-penetrate to a varying extent while the remote faces of each layer are flat. More complex patterns may be formed by superposition and assembly of two or more composite elements formed as described above, or by making individually and then assembling a series of layers each having complementary adjacent surfaces and each being differently coloured, the thickness of which varies in accordance with the density of shade in the portion of the pattern which it is intended to represent. It is also possible to include in the assembly of layers an opaque backing or inter-layer so that the pattern may be viewed from one side by reflected light, or so that a pattern may be viewed from either side by reflected light. The invention enables patterns of the most varying type to be reproduced with accuracy, the natural less, full effect or beauty of which may be appreciated either by transmitted light or reflected light in a substantial thickness of plastic material.

The patterns produced are different from printed or inlaid patterns in that they inter-penetrate and possess absolute gradations and inter-fusions of tone or colour without screen or grain. Such patterns may be original inventions or reproductions of patterns existing in nature, such for example as tortoiseshell, marble, onyx, horn, shell, amber, foliage or the like. Patterns existing in various manufactured material such as enamels, stained glass, parchment, silks, brocades and the like may also be reproduced. Natural patterns such as tortoiseshell may be reproduced in pieces of greater area than exist in nature by reproducing and extending its pattern. Alternatively, patterns may be entirely invented to simulate closely natural patterns in any shape or on any scale.

For convenience in description the layer or layers corresponding to the darker parts of the pattern will be termed the pattern layer, and the layer corresponding to the lighter or colourless parts will be termed the groundwork layer.

When constructing a simple pattern consisting of a single pattern layer and a single groundwork layer, a platen plate is first constructed whose surface is contoured to represent a contoured image of the desired pattern in which the depth of the depressions represents the density of the pattern at these points. Such a plate may be produced by hand engrav-

[Price 2/-]

ing a metal plate or by casting from a plaster or the like mould made by hand, but it is generally more convenient to use a photographic or heliographic process for producing the plate. In general, a photographic negative or diapositive of the desired pattern will be produced and transferred by a known method to a suitable light sensitive medium such as bichromated gelatine to form a relief which is then cast from, or hardened and pressed into the metal plate.

Alternatively, the plate for the groundwork layer may first be made by the same method.

To obtain an increase of the limited depth of contours obtainable from a bichromated gelatine relief, two or more casts in gelatine are made successively from the first relief and exposed to the same negative or diapositive until sufficient increase of depth is produced.

Where a completely transparent patterned material, e.g. tortoiseshell is used as the model, it may itself be used as the diapositive.

The metal plate so made is used as a mould in which to cast the plastic material of a layer when it is in a liquid or viscous condition or as a die for striking into a uniformly coloured sheet or a colourless sheet of plastic material resting on a flat surface so as to form the contoured surface in contact with the platen plate to the requisite contour. The layer so formed is hardened and constitutes either the pattern layer or the groundwork layer. A second sheet of plastic material differently but uniformly coloured or colourless to form the groundwork layer is then cast or pressed into the contoured face of the layer first formed, a flat plate serving to apply pressure so as to squeeze out surplus material and ensure adhesion of the two complementary layers which will finally have flat external surfaces.

Still further alternative methods of forming the first contoured layer are by pressing an appropriate apertured screen into a mass of plastic material in molten or plastic form so as to cause the material to well up through the apertures in the screen and then causing the material to solidify or harden, or by controlling by apertured screens the fall of particles of plastic material in solid form and then heating or otherwise treating the material to render it soft and coherent so as to convert the particulate mass into a coherent mass.

For more complex patterns, composite elements composed of a pattern layer and a groundwork layer having flat external surfaces may be superposed and assembled either by heat and pressure, or by the use of a suitable solvent or plasticiser to build up the desired number of composite elements giving the required pattern.

Alternatively, for the manufacture of more complex patterns a composite element, comprising two superficial groundwork layers between which are interposed a number of directly adjacent pattern layers, may be assembled. In this case, each face of each pattern layer must be contoured, and for convenience in description, the face which is contoured to define the masses and gradation of the pattern will be referred to as the superior face, while the opposite face which must fit the superior face of the adjacent layer will be referred to as the inferior face. The superior face may be produced by printing from a composite negative, consisting of the negative image of the portion of the pattern which the pattern layer is to represent and the diapositive of the portion of the pattern represented by the adjacent pattern layer whose superior face is to be accommodated. The inferior face is formed by casting or pressing on the adjacent superior face of the layer which has already been formed or by casting in a mould which is identically contoured with that face. The nature of the plastics and the methods of moulding and hardening them may be very varied and, in general, any transparent or translucent plastic material capable of being worked satisfactorily may be employed. A convenient example is polymethyl methacrylate. When it is desired first to mould one sheet and then to mould or cast the other layers *in situ*, it is convenient that the plastics should be different or include different amounts of plasticiser or be at different stages of polymerisation. In this way, where heat and pressure are used to form the second and/or succeeding layers and unite them to the first layer, plastics may be employed such as those in which the softening points enable them to be used successively as mould or die to form a complementary layer. Alternatively, the first layer or each layer before the last layer may be subjected to further hardening treatment before the next layer is formed.

The final patterned sheet may in itself constitute a patterned article, or a number of such sheets may be assembled in any relative position to build up an article, or may be used to be embodied in an article other parts of which may be formed of plastic or other material.

Dated this 27th day of November, 1947.

For the Applicant:
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COMPLETE SPECIFICATION

Improvements in or relating to Laminated Patterned Plastic Articles

I, GEORGE CLAUDE LEON UNDERWOOD, a British Subject, of 12, Girdlers Road, West Kensington, London, W.14, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

The invention relates to laminated patterned plastic structures, being articles or parts of articles.

In accordance with the invention, a structure is formed by assembling without distortion laminæ of transparent or translucent plastic material at least two of said laminæ being of uniform but different colour and varying in thickness and having non planar complementary contiguous surfaces, so that the structure shows a pattern having gradations in the density of one shade in a groundwork of a different shade. In this way a parallel faced structure is formed having a pattern in which the depth of shade at various points is controlled by the thickness of the corresponding coloured lamina; in this way it is possible to form simple patterns in which there is variation in the density of a single shade in a uniform groundwork which may be coloured or colourless, or more complex patterns in which the density of two or more shades vary. The variation of both colour and thickness of the laminæ is complementary, in the optical sense in that the coloured laminæ fit together to form the visual pattern and its groundwork, and in the structural sense, in that two of them at least have one flat face each, which enables them all to be assembled into a pattern consisting of a uniform sheet of flat and parallel faces, without undue distortion of the visual pattern.

In a simple form, a pattern structure may consist of two such laminæ each distinctively coloured or one coloured and the other clear, the darker of which is formed with one face flat and the other being contoured to give the required pattern, and the lighter of which, or the clear layer forms the groundwork for the pattern and which has one surface contoured in a manner complementary to the contoured surface of the darker lamina. The two laminæ are superposed, or one is formed *in situ* in the other so that their two contoured faces mate and interpenetrate to an extent which varies with the pattern while the remote faces of each lamina are flat. More complex patterns may be formed by superposition and assembly of two or composite elements formed as described above, or by making individually and then assembling a series of laminæ each having complementary adjacent surfaces and each being differently coloured, the thickness of which varies in accordance with the density of shade in the portion of the coloured pattern which it is intended to represent. It is also possible to include in the assembly of laminæ an opaque lamina as a backing or inter-layer so that the pattern may be viewed from one side by reflected light, or so that a pattern may be viewed from either side by reflected light. The invention enables patterns of the most varying type to be reproduced with accuracy, particularly those in which the naturalness, full effect or beauty is visible beneath the surface and is capable of being appreciated in a substantial thickness of plastic material when viewed by either transmitted or reflected light.

The patterns produced are different from printed patterns in the visual effect given to them by depth, and from inlaid patterns in that they may possess controlled and absolute gradations and interfusions of tone or colour without screen or grain. Such patterns may be reproductions from nature, such for example as tortoiseshell, marble, onyx, horn, shell, amber, foliage or the like. Patterns existing in various manufactured material such as enamels, stained glass, parchments, silks, brocades and the like and photographs, paintings and drawings may also be reproduced. Natural patterns may be reproduced in pieces of greater area than exist in nature. Alternatively, patterns may be entirely invented to simulate closely natural patterns.

For convenience in description, the lamina or laminæ corresponding to the darker parts of the pattern will be termed the pattern layer, and the lamina corresponding to the lighter or colourless parts will be termed the groundwork layer.

When constructing a simple pattern

such as tortoiseshell consisting of a single pattern layer and a single groundwork layer, a relief plate is first constructed whose surface is contoured to represent a contoured image of the varying dispositions and graduation of the darker coloured material in which the configurations of the pattern are represented by the depth of the depressions at these points. Such a plate may be made by hand, cast, pressed or electrotyped from a hand made model but it is generally more convenient to use a photographic or light sensitive medium such as bichromated gelatine, for the production of the relief plate. In general, a photographic negative or diapositive of the desired pattern will be produced and transferred by a known photographic or heliographic method to a suitable light sensitive medium such as bichromated gelatine to form a relief which is then cast from electrotypes or hardened and pressed into a soffer metal plate.

Alternatively, a relief plate for the groundwork layer may first be made by the same method. When this procedure is followed the pattern layer is generally made *in situ* in the groundwork layer from plastic material in a liquid, viscous, pasty, granulated or finely powdered state.

Where a drawing made on a transparent base or a completely transparent patterned material, e.g. tortoiseshell is used as the model, it may itself be used as the diapositive in the production of a relief plate or plates by photographic or heliographic means.

The metal relief plate so made is used as a mould in which to preform the plastic material of a lamina when it is in a granulated, powdered or pasty condition or to cast it when it is in a liquid or viscous condition or as a die for pressing it out in a uniformly coloured layer or a colourless layer of plastic material resting on a flat surface so as to form the contoured surface in contact with the plate to the requisite contour. Alternatively, a metal relief plate so formed is used to press out a mould in plastic material, which is filled in with plastic material of the coloured lamina as described. The lamina so formed is hardened. A second sheet of plastic material differently but uniformly coloured or colourless to form the groundwork of the pattern is then cast or pressed into the contoured face of the layer first formed, a flat plate serving to apply pressure so as to squeeze out surplus material and ensure adhesion of the two complementary layers which will finally have flat external surfaces.

Still further alternative methods of forming a contoured lamina for use in accordance with the invention are by pressing an appropriate apertured screen into a mass of plastic material in molten or plastic form so as to cause the material to well up through the apertures in the screen and then causing the material to solidify or harden, or by controlling by apertured screens the fall of particles of plastic material in solid form and then heating or otherwise treating the material to render it soft and coherent so as to convert the particulate mass into a coherent sheet.

For more complex patterns, compound laminæ each composed of a pattern layer and a groundwork layer having flat external surfaces may be superposed and assembled either by heat and pressure, or by the use of a suitable solvent or plasticiser to build up the desired number of compound laminæ giving the required pattern.

Alternatively, for the manufacture of more complex patterns a compound lamina, comprising two superficial groundwork layers between which are interposed a number of directly adjacent pattern layers, may be assembled. In this case, each face of the lamina representing each pattern layer must be contoured, and for convenience in description, the face which is contoured to define the masses and gradation of the pattern will be referred to as the superior face, while the opposite face which must fit the superior face of the adjacent lamina will be referred to as the inferior face. The superior face may be produced by printing from a composite negative, consisting of the negative image of the portion of the pattern which the pattern layer is to represent and the diapositive of the portion of the pattern represented by the adjacent pattern layer whose superior face is to be accommodated. The inferior face is formed by casting or pressing on the adjacent superior face of the layer which has already been formed or by casting in a mould which is identically contoured with that face.

The nature of the plastics and the methods of moulding and hardening them may be very varied and in general, any transparent or translucent plastic material capable of being worked satisfactorily may be employed. Convenient examples are polymethyl methacrylate and cellulose acetate. When it is desired first to mould one lamina and then to mould or cast the other laminæ *in situ*, it is convenient that the plastics should be different or include different amounts of plasticiser or be at different states of preparation or stages of polymerisation.

In this way, where heat and pressure are used to form the second and/or succeeding laminæ and unite them to the first lamina plastics may be employed such as those in which the softening points enable them to be used successively as mould or die to form a complementary lamina. Alternatively, the first lamina or each lamina before the last layer may be subjected to further hardening treatment before the next lamina is formed.

The invention is further illustrated in the following examples:—

EXAMPLE 1.

In the production of a tortoiseshell pattern from two laminæ of cellulose acetate, the following procedure was followed.

A photographic negative was made from tortoiseshell by exposing a photographic plate in contact with it, using tortoiseshell as a diapositive, and the negative image was converted into a negative relief by exposing bichromated gelatine in contact with it. This relief was converted into a metallic relief plate by electrotyping. To construct the lamina constituting the lighter coloured or groundwork layer from this relief plate, a suitably coloured and plasticised cellulose acetate sheet was placed between it and a smooth plate in the press and heat and pressure were applied. A second sheet of cellulose acetate more darkly coloured than the first was pressed and formed into a complementary lamina by pressing it in a negative relief plate prepared by deposition of metal on the electrotype from which the groundwork layer was prepared. The laminæ are then superposed in accurate register and pressed whilst heating so that they unite.

EXAMPLE 2.

A wood grain pattern was prepared from an assembly of four superposed laminæ. For this structure, two electrotypes are prepared. The first electrotype represented the surface grain of the wood in relief on a flat field. This is prepared from a photograph of the wood, the surface grain having been prepared by filling it with whiting and then inking the remainder of the surface to obscure the under grain. The surface grain pattern lamina was prepared from this electrotype by casting or pressing from it a lamina of uniformly coloured plastic which reproduced the pattern of the surface grain in intaglio form, and then by wiping or dusting in to its intaglio recesses a high melting point hard fine moulding powder of cellulose acetate containing a small proportion of plasticiser.

The second electrotype representing the under grain is prepared by filling the surface with a neutral coloured filling to obscure the surface grain and then polished to reveal the under grain. A composite lamina is produced from this by wiping or dusting in as before a lacquer of cellulose acetate in a volatile solvent to form the groundwork layer. The solvent in the lacquer serves to cause the moulding powder to become coherent and unitary. After the solvent has evaporated the composite lamina is stripped off the electrotype.

The two composite laminæ are then superposed with the cellulose acetate layers contiguous heated and pressed together till the plasticised layers soften and allow the harder layers to become embedded in them.

EXAMPLE 3.

In this example a reproduction in plastic of a three colour print was produced by superposing four laminæ. The print was first photographed successively through three colour screens to give images representing yellow, magenta and peacock blue-green in the print.

For the lamina representing the yellow pattern of the image an electrotype was formed from a photograph taken through the corresponding colour screen and the lamina was formed by the method described in Example 1. A second electrotype was produced representing the peacock blue-green and a lamina similarly formed from this electrotype. Each of these two laminæ had one flat and one contoured face and occupied the outside positions in the structure, the yellow lamina being regarded as the uppermost for convenience in description. The magenta layer which was laid adjacent to the yellow layer was given on its upper surface contours complementary to the contoured face of the yellow lamina. To form that face a negative relief plate is formed by deposition of metal on the electrotype from which the yellow lamina was prepared.

The under face of the magenta lamina was so contoured that the total thickness of that lamina varied in accordance with the depth of magenta shade in print. For this purpose an electrotype was constructed from a combination of a photographic negative taken with the magenta screen and a photographic diapositive of the negative produced with the yellow screen. The lamina representing magenta was then formed by pressing a sheet of cellulose acetate between the two electrotypes representing its upper and lower surfaces.

The yellow and magenta laminæ have complementary contoured faces but between the upper surface of the peacock blue-green lamina and the lower surface of the magenta lamina there was interposed a sheet of clear cellulose acetate which is softer and more highly plasticised than the composition of the magenta and peacock blue-green laminæ. The whole structure was then heated in the press to unite the laminæ and to cause the clear lamina to be deformed so that its upper and lower surfaces were complementary to the adjacent surfaces of the magenta lamina and of the peacock blue-green lamina.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is:—

1. A method for the production of a structure by assembling without distortion laminæ of transparent or translucent plastic materials at least two of said laminæ being of different but uniform colour and varying in thickness and having non-planar complementary contiguous surfaces so that the structure shows a pattern having gradations in the density of one shade in a groundwork of a different shade.

2. A method as claimed in claim 1 in which there are two transparent or translucent laminæ each having one flat and one contoured face.

3. A method as claimed in claim 1 having three or more laminæ at least one of which has both faces contoured.

4. A method as claimed in any of the foregoing claims in which the structure includes an opaque backing or interlayer so that the pattern may be viewed by reflected light.

5. A method for forming a structure as claimed in claim 2 in which one lamina is shaped to the desired contour by forming it in a mould and the other lamina is produced by forming it in a second and complementary mould.

6. A method as claimed in claim 1 using more than two contoured laminæ, which process comprises forming two or more compound laminæ having parallel surfaces, each compound lamina comprising two component laminæ one face of each of which is contoured and the other flat, and uniting the compound laminæ by heat and pressure.

7. A method as claimed in claim 5 or 6 in which the mould for the initial casting or pressing operation is produced by a heliographic or photographic process.

8. A method for the production of a patterned structure as claimed in claim 3 and in which a lamina located between the outside laminæ has two contoured faces one of which is cast from or pressed in a mould formed by a photographic or heliographic process from a composite negative composes of a negative of the shade which the lamina is to represent and the diapositive of the shade to be represented by the lamina remote from that face, and the other face being formed complementary to the adjacent face of the next lamina.

9. A patterned structure comprising superposed and united laminæ of translucent or transparent material whenever produced by a method as claimed in any of claims 1 to 8.

Dated this 22nd day of November, 1948.
For the Applicant:
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